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PRESSING PLANTS WITH DOUBLE-FACED CORRUGATED PAPER BOARDS.

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The advantages to be gained by using corrugated paper boards in plant presses was first made widely known by Collins who, in 1910,[1] described his own experience with them, together with that of several other workers who independently had developed similar methods. Briefly outlined, the scheme originally employed by Collins was as follows. In building up a press, single-faced (s. f.) corrugated boards, i. e. boards in which one face is uncovered and ridged, the other covered and smooth, were substituted for the driers customarily employed, the specimens, enclosed only by thin specimen sheets of newspaper stock, being laid directly between these. After being strapped up the press was suspended over a lamp, and around it was tied a cloth skirt, draped so as to hang nearly to the floor, and "held open by means of a stiff wire hoop sewed in at the lower edge." The effect of the continuous current of warm air from the lamp, guided by the skirt and passing upward through the corrugated ventilators, was such that, to quote Collins (*l. c.*, p. 222), "plants which formerly took a week to dry can almost invariably be perfectly dried in less than 24 hours, and commonly in less than 12 hours." Furthermore, there was the added advantage that the bother of changing driers and spreading out the wet ones to dry was entirely eliminated.

Collins experimented with various modifications of the method

[1] Collins, J. F. The use of corrugated paper boards in drying plants. Rhodora **14**: 221–224. 1910.

just described and found that somewhat better specimens could be obtained, though not so quickly, by using ordinary driers in combination with the corrugated ventilators: a drier was placed over the ridged face of each board, so that the sheet containing the specimen lay between a drier on one side and the smooth face of a ventilator on the other. This scheme was essentially the one used in the field by Professors M. L. Fernald and K. M. Wiegand, "except that one change of driers was made in order to straighten folded leaves, etc." (*l. c.*, p. 223). It was found that such a press could be left without attention for several days, even in a humid climate. Finally, Collins suggested the practicability of using various sources of heat other than the lamp, such as an oil stove, electric heater, cook stove, steam radiator, etc.

Three years later Ricker,[1] in a government circular designed primarily to instruct novices in the preparation of presentable botanical specimens, recommended the use of corrugated boards in combination with driers for pressing, advising that the specimen sheet be separated from the ventilators on both sides by driers. He recommends double-faced (d. f.) boards, i. e. boards with both faces covered and smooth, in preference to the single-faced type, and stipulates that the corrugations should run lengthwise the board. Regarding the use of the d. f. board Collins (*l. c.*, p. 223) was of the opinion that although "it is better to handle, and can be used either side up, it appears doubtful at present if it has any particular advantages otherwise over the single-faced."

The primary object of the present paper is to proclaim the advantages of the d. f. board ventilators, and to describe briefly our experience in using them under diverse conditions, with the hope that others may profit by our results. During the summer of 1915 and again in 1916 the senior writer spent about two months in ecological investigations in northern Cape Breton.[2] As a desirable adjunct to these studies considerable attention was devoted to the flora of the region, and something over 2000 sheets of vascular plants were prepared. For pressing and drying, d. f. corrugated boards, cut with the corrugations running lengthwise, were used, driers being omitted except with occasional

[1] Ricker, P. Z. Directions for collecting plants. U. S. Dept. Agr. Bur. Pl. Ind. Cir. 126. pp. 27–35. *f. 1–5.* 1913.

[2] See Nichols, G. E. The vegetation of northern Cape Breton Island, Nova Scotia. Connecticut Acad. of Arts & Sciences **22:** 249–467. f. 1–70. 1918.

bulky specimens. Altogether only about 75 boards were taken into the field. The general scheme followed was that described by Collins and needs little further comment. As a source of heat an ordinary kerosene lantern was used. Incidentally, in this connection, it was found that, in addition to an abundant supply of oil, a stock of extra wicks was essential, since, with the lantern running continuously day and night, the wick had to be well trimmed at least once and preferably twice a day. About a month of each summer was spent in permanent camp, and during this period the press was hung in a special shelter: the first summer in a makeshift tent, roofed with tarpaulin and walled with boughs; the second summer in a small hut constructed out of tar-paper and scantlings. The latter part of each summer was spent partly in localities where "hotel" accommodations were available, partly in trips of about a week's duration through an uninhabited wilderness where all luggage had to be packed and carried. On these latter jaunts little attempt was made to dry specimens properly, but at the hotels it was customary to run the press as usual, suspending it by means of home-made wire hooks between the backs of two chairs.

The experience gained during these two summers demonstrated conclusively the worth of d. f. driers. As a rule plants were left in the press for 24 hours, the press being reversed at the end of 12 hours to insure even drying toward both ends of the press. This length of time sufficed to completely dry ordinary specimens, and even *Mertensia*, a notoriously difficult subject, was out of the press within three days. It should be interpolated, however, in the light of more recent experience, that boards cut with the corrugations running crosswise give more satisfactory results than those with corrugations running lengthwise. With the latter there is a tendency for parts lying near the center of the press to dry slowly, a tendency which is quite obviated where the corrugations run crosswise. The specimens prepared by the method just described are all that could be desired, and are noticeably superior to those prepared with the help of s. f. driers alone. Even *Mertensia* makes a fairly presentable specimen, retaining its color at least much better than any other specimens we have seen. As might have been expected, by the end of the first summer all of the ventilators showed unmistakable signs of service, and many of those that had had the misfortune to lie next to bulky specimens were pretty much out of commission. But that they stood up well under the test is demonstrated by the fact that many of them were again used throughout the second season.

In July, 1917 we contemplated a long, hard canoe trip in northwestern Maine, with the collection of plants as our primary object. From the start nearly to the finish of our 250 mile journey we realized that it would be necessary to depend on what could be carried in two canoes, together with what could be obtained from the woods. It was obvious that botanical equipment must be reduced to a minimum and yet at the same time be absolutely dependable. In view of the satisfactory results obtained by the senior writer with d. f. ventilators, this part of the equipment was quickly settled upon. A second matter demanding attention was the source of heat. With the prospect of long, hard days of poling and dragging the canoes upstream and of at least one long portage we hesitated about loading down with a three weeks supply of oil. So, at the suggestion of the junior writer, it was decided to place our dependence on a campfire — with what success will be seen. In addition, then, to sundry press frames, straps, and specimen papers, our equipment for preparing specimens, as finally boiled down, consisted of two hundred d. f. corrugated boards, cut with the corrugations running crosswise, fifty Washington driers (the purpose of which will be pointed out presently), and an abundant supply of matches. Thus armed, we sallied forth into the wilderness.

In the preparation of specimens our general method of procedure was somewhat as follows. The freshly collected plants were placed in pressing papers and press number one was built up of these plus occasional interlarded driers. It will be seen that driers were not eliminated completely, but for the most part they were used only in connection with this first press, and here primarily to place on either side of the heaviest plants, thus protecting their neighbors from undue crushing. To a certain extent they were also used between groups of specimen sheets and to even up the press. For these purposes it was not necessary that they should be thoroughly dried out after each application. Press number one was then strapped up tightly and set aside for from twelve to twenty-four hours. Ordinarily it traveled a day in the canoe, wrapped securely in a waterproof bag. At the end of this time it would be unstrapped and the entire bale of plants carefully worked over, leaves which were crumpled or out of place being straightened or shifted, flowers or fruits being brought into due prominence, etc. From the specimens thus treated would be built up press number two, this time with a ventilator alternating

with every specimen sheet. After this fashion a stack might be built up to a height of sometimes two feet or more.

In strapping up this final press, the straps were placed crosswise the press, a foot or more apart, with both buckles on the same side of the press — one of the open sides. For straps, broad, webbing trunk straps were used: these can be adjusted much more easily than leather straps and are much stronger. These straps were twelve feet in length and by tying together the free ends, a loop of any length desired could be made, by which the press could be hung up to dry.

The press was now ready for the fire. At first thought it seemed like tempting Providence to entrust our plants to an open fire, but experience showed that with due care there was little danger. Only twice during our trip, the first and the last day in camp, did any catastrophe threaten: the first time due to lack of experience, the last due to an overzealous attempt to exceed the speed limit in the drying process. On both occasions the press was rescued before any serious damage had been done.

The matter of fuel was the occasion of considerable experimentation. Coniferous wood burns too rapidly and flares up too much. Of the woods available in the region traversed, alder makes the hottest fire, but the sticks are small and a green alder fire of the sort required demands constant nursing. We finally settled on green paper birch. This was everywhere available, was easy to cut and split, and once started produced a hot fire, but without too many sparks or too much flame and smoke, a fire which could be depended on for a maximum continuous supply of heat with a minimum amount of attention, especially after it had been tamed down to a glowing bed of coals.

For holding the press in position over the fire a tripod was constructed from light saplings about ten feet long, bound together at the smaller ends with a piece of cord. The tripod was straddled over the fire and the press suspended from the projecting end of one of the saplings (one of which it was our custom to cut short for this purpose), broadside over the fire and at such an angle that the channels in the ventilators would lie in a vertical position. The height of the press above the fire was determined approximately beforehand by lengthening or shortening the loop, but both height and position could be subsequently regulated by shifting the legs of the tripod. With a slow fire the press could be left at a height of barely two feet above the coals without danger, but the "coefficient of safety" naturally varies and can be judged only by experience.

The results obtained by the method just described were fully as satisfactory as those secured when a lantern was used as a source of heat, and indeed material could be dried even more rapidly. Under favorable conditions completely dried specimens could be turned out in from three to five hours: specimens in which the natural color was retained far more perfectly than in plants prepared by the ordinary slower methods of drying, and which showed no ill effects from their hot air treatment save a slight smoky smell which soon vanished. Only in exceptional cases was the imprint of the corrugations to be detected in the finished product. Wind and rain were two of the chief enemies with which we had to contend. To avoid the former we always looked for a sheltered pocket among the evergreens where the tripod could be set up. Sometimes we rigged up a make-shift wind-break with a pack-cloth, while in wet weather a pack-cloth draped tepee-fashion around the top of the tripod served the double end of keeping the press dry and the fire alive. These, however, are two enemies against which on another trip more preparation would be made beforehand.

As with the lantern method, the d. f. ventilators stood up remarkably well. They showed some effects of their hard usage, to be sure, and after being in service for a week, with the smoke constantly rising through their pores, they began to smell like a lot of kippered herring, but what real camper would object to that! And notwithstanding that all the ventilators were in practically continuous service for twenty-four days, not one was actually rendered useless.

In conclusion, a few observations of a general nature regarding the relative merits of the current methods of drying vascular plants for herbarium specimens. The following remarks pertain more especially to field operations, but in large measure they are quite as applicable to herbarium or home practise. In the matter of driers or their "equivalents", four possibilities are open: driers, s. f. ventilators, s. f. ventilators plus driers, and d. f. ventilators. Furthermore there is the choice between various sources of artificial heat or no artificial heat at all. In deciding upon the relative efficiency of various methods, there are perhaps five principal factors to be taken into account: (1) length of time required to dry specimens and (2) quality of results; and (3) weight, (4) durability, and (5) convenience in handling of the drying equipment. Sufficient objections to driers alone are furnished by the first and third factors; to s. f. ventilators

alone by the second and fourth. As to the relative merits of s. f. ventilators plus driers versus d. f. ventilators, it should be said that the results obtained with the former of these two equipments are quite equal to those obtained by the latter, but the first, third, fourth and fifth factors mentioned above are all in favor of the d. f. ventilators. Using the first equipment it takes several days to dry a load of plants, while with the second a full capacity load can be turned out each day. In this connection it should be remarked that the "Washington" drier is far superior to the ordinary type in its greater absorbent power, thinness, firmness, and strength. So far as bulk and actual weight are concerned, equal quantities of s. f. ventilators plus driers, on the one hand, and of d. f. ventilators, on the other, are about equally matched: one hundred d. f. ventilators were found to weigh $28\frac{1}{4}$ pounds, as compared with $15\frac{5}{8}$ and $13\frac{1}{4}$ pounds for the same quantities of s. f. ventilators and Washington driers respectively. But the great saving in both bulk and weight is seen when account is taken of the speed with which results can be obtained by using the d. f. ventilators. On an extended collecting trip a given number of d. f. ventilators will turn out as many dried specimens as three or four times their number of s. f. ventilators plus driers. Add to this the greater convenience in handling and the superiority of the d. f. ventilators can hardly be questioned.

With regard to the use of artificial heat, it is our opinion, based on several years' experience, that so far as the quality of results is concerned no potent objection can be urged against it: on the contrary, as earlier indicated, the specimens dried in this way are obviously superior to those dried without heat. Moreover the saving of time and energy and, in the field, of weight and bulk are big items. As to the source of heat, for field work either a lantern or a fire is satisfactory. It must be admitted, however, that a fire does require more or less constant attention, and that on this account, where it is practicable, a lantern is to be preferred, since, while it does not produce results quite as rapidly, the lantern requires much less supervision and can be left on duty day and night.

For use in the laboratory the senior writer has found great satisfaction in the following equipment. A rectangular wooden box about three feet high and open at the top was constructed. The width of the box is slightly more than the length of a pressing frame; its length is immaterial, but is sufficient to accommodate a press about two feet

thick. An inch or so below the rim of the box, lengthwise on either side, was fixed a wooden ledge. The press, instead of being suspended from above, is supported on this ledge and is girded with a canvas skirt which hangs down well below the upper edge of the box. As a source of heat a small electric stove is used, the connecting cord of which passes out through one of several holes which have been bored in the sides of the box near the base.

THE SPECIFIC VALIDITY OF LIMOSELLA SUBULATA.

M. L. FERNALD.

ONE of the most characteristic plants of tidal flats, brackish shores and borders of salt marshes in eastern North America is the little matted and creeping plant which is known in our floras as *Limosella aquatica*, var. *tenuifolia*, or sometimes as a distinct species, *L. tenuifolia*. Our plant, treated either as a variety of *L. aquatica* L. or as a species, *L. tenuifolia* Wolf, is thus inferred to be identical with the European *L. tenuifolia*. But so far as the writer is able to determine, Wolf's species, *L. tenuifolia*,[1] is merely a dwarfed form of the European *L. aquatica*, with the leaf-blade very short and linear instead of narrowly elliptic. This is the estimate of the European *L. tenuifolia* by essentially all European authors, including Hoffmann who originally published it not as a true species but as subordinate to *L. aquatica*; and it has been so regarded in Europe for nearly a century, Schübler & Martens as early as 1834 calling it *L. aquatica* β. *L. tenuifolia*,[2] a nomenclatorial combination which has been repeatedly published as new by different subsequent authors even down to the year 1909.

Limosella aquatica L. is a characteristic European plant found also in southern Labrador and generally over the western portions of temperate North America, having leaves with definite blades varying from oblong to elliptic in the commoner form of the plant or narrowly oblanceolate to barely linear in the more reduced forms (var. *tenuifolia*).

[1] Wolf. ex Hoffm. Deutsch. Fl. ed. 2, i. part 2, 29 (1804).
[2] Schübler & Martens, Fl. von Würtemb. 396 (1834).